Remarks/Arguments:

Preliminary Matters

Claims 1 – 20 are pending in the present case. Claims 5 - 7 stand objected to due to informalities. Claims 5 - 7 have been amended accordingly, and it is respectfully submitted that these claims are currently in condition for allowance.

35 U.S.C. § 102

1) Claims 1, 4, 5, 7 - 10, 12, 13, 15 - 18, and 20 stand rejected under 35 U.S.C. § 102(b) as anticipated by U.S. Patent No. 4,521,311 to Fuchs et al. Applicant respectfully traverses the rejection of these claims and respectfully submits that these claims are patentable over Fuchs for at least the reasons set forth below.

Independent claim 1, as amended, recites features that are neither disclosed nor suggested by Fuchs, namely:

> A bioreactor comprising: a vessel having a bottom region and an interior configured to contain an aqueous suspension of biomass and media; a first gas outlet at the bottom region of the vessel, said first gas outlet positioned to introduce *a first stream of gas providing a first plurality of cavities* to promote growth of said biomass on said media; a lift tube disposed within the vessel, the lift tube having an inlet disposed at the bottom region of the vessel; and a second gas outlet positioned to feed gas into the lift tube at a location proximal to the inlet of the lift tube, said second gas outlet configured to introduce *a second stream of gas providing a second plurality of cavities* to promote separation of said biomass from said media in said lift tube, wherein *said second gas outlet is configured to introduce cavities larger than said cavities introduced by said first gas outlet.*

Applicant's invention differs from that of Fuchs in that the Fuchs patent does not disclose or suggest a bioreactor that comprises a second gas outlet providing a second plurality of cavities to promote the separation of biomass from the media, wherein the second gas outlet is configured to introduce cavities larger than the first gas outlet. In fact, in column 6, lines 13-40, Fuchs teaches away from Applicant's invention because Fuchs uses a compression means as seen in Figure 1, item 13 of the patent, to provide the shear forces necessary to separate the biomass and regenerate support particles. In contrast, Applicant discloses on page 7, lines 3-11 that larger cavities can supply both oxygen delivery and shear force interaction for biomass separation, while smaller cavities are used for oxygen mass transfer. The advantages of this feature, as explained on page 8, lines 23-25, is a reduction in overall gas and energy supplied to the system.

Applicant's invention further differs from that of Fuchs because in column 2, lines 21-30 of the Fuchs patent, Fuchs discloses that the filter zone is preferably free of turbulence and that the formation of large voids has a "detrimental effect on the filter process." However, in Applicant's invention, turbulence is optionally encouraged by the use of the second gas outlet that provides a second plurality of cavities which are larger than the cavities of the first outlet. Thus, for the reasons set forth above, claim 1, as amended, is patentable over Fuchs.

Independent claims 9 and 18, as amended, while not identical to claim 1, include features similar to claim 1. Claim 9 recites, among other features, a method for promoting biomass growth and separating biomass from the media in a bioreactor. A first stream of gas is introduced, providing *a first plurality of cavities* into the bioreactor to promote the growth of biomass on the media. A second stream of gas is introduced, providing *a second plurality of cavities* into the bioreactor near an inlet of a lift pipe to generate sufficient shear forces to separate biomass from the media. *The second stream of gas introduces cavities larger than the first stream of gas.* Similarly, claim 18 recites, among other features, a method for use in a bioreactor comprising a vessel having an interior configured to contain an aqueous suspension of biomass and media and a lift tube having an inlet. A first stream of gas is introduced, providing *a first plurality of cavities* into the bioreactor to promote the growth of the biomass on the media. A second stream of gas is introduce, providing *a second plurality of cavities* into the inlet of the lift tube to generate shear forces to separate the biomass from the media. *The second stream of gas introduces cavities larger than the first stream of gas.* Accordingly, claims 9 and 18 are also patentable over Fuchs et al. for the reasons set forth above.

Claims 4, 5, 7, and 8 include all the features of claim 1 from which they depend; claims 10, 12, 13, and 15-17 include all the features of claim 9 from which they depend; and claim 20 includes all the features of claim 18 from which it depends. Therefore, claims 4, 5, 7, 8, 10, 12, 13, 15-17, and 20 should also be allowed at least as dependent upon their respective allowable base claims. Thus, for the reasons set forth above, claims 1, 4, 5, 7 - 10, 12, 13, 15 - 18, and 20 are patentable over Fuchs. Withdrawal of the rejection under 35 U.S.C 102(b) is respectfully requested.

2) Claims 1, 2, 4, 5, 7 - 10, 12, 13, 15 - 18, and 20 stand rejected under 35 U.S.C. § 102(e) as anticipated by U.S. Patent No. 6,616,845 to Shechter et al. Applicant respectfully traverses the rejection of these claims and respectfully submits that these claims are patentable over Shechter for at least the reasons set forth below.

Independent claim 1, as amended, recites features that are neither disclosed nor suggested by Shechter. As explained above with reference to the Fuchs patent, claim 1 recites, among other things, a bioreactor including a vessel, *wherein a second gas outlet is configured to introduce cavities larger than a first gas outlet*.

Applicant's invention differs from that of Shechter in that the Shechter patent neither discloses nor suggests a bioreactor that comprises a second gas source and outlet to provide a second plurality of cavities to promote the separation of biomass from the media, wherein the second gas outlet is configured to introduce cavities larger than the first gas outlet. In fact in column 7, lines 37-67, Shechter teaches away from Applicant's invention because Shechter uses water flows, as depicted by arrows in Figures 4, 5, and 7, to provide the shear forces to separate the biomass. Nowhere does Shechter disclose the use of cavities for biomass separation. In column 8, lines 20-23, Shechter discloses that the air diffusers control flow velocity between air lifts and provide aeration to the water. In contrast, Applicant teaches on page 7, lines 3-6, that the larger cavities provide the shear force for biomass separation. The advantage of this feature, as explained on page 8, lines 23-25, is a reduction in overall gas and energy supplied to the system.

Thus, according to the reasons set forth above, claim 1 is patentable over Shechter. As explained above with reference to the Fuchs patent, independent claims 9 and 18, as amended, while not identical to claim 1, include features similar to claim 1. Accordingly, claims 9 and 18 are also patentable over Shechter for the reasons set forth above.

Claims 2, 4, 5, 7, and 8 include all the features of claim 1 from which they depend, claims 10, 12, 13, and 15-17 include all the features of claim 9 from which they depend, and claim 20 includes all the features of claim 20 from which it depends. Therefore, claims 4, 5, 7, 8, 10, 12, 13, 15-17, and 20 should also be allowed at least as dependent upon their respective allowable base claims. Thus, for the reasons set forth above, claims 1, 2, 4, 5, 7 - 10, 12, 13, 15 - 18, and 20 are patentable over Shechter. Withdrawal of the rejection under 35 U.S.C 102(e) is respectfully requested.

35 U.S.C. § 103

1) Claims 6 and 13 stand rejected under 35 U.S.C § 103(a) as unpatentable over Shechter or Fuchs in view of Steel and McGhee, "Water Supply and Sewerage," 1979, pages 503, 508, and 509. Applicant respectfully traverses the rejection of these claims and respectfully submits that these claims are patentable over Shechter and Fuchs in view of Steel for at least the reasons set forth below.

As explained above, claims 6 and 13 include features that are not present in Shechter nor Fuchs. Furthermore, the teachings of Steel do not disclose shear forces supplied by large cavities, but rather teach the oxygen transfer efficiency of bubble aerators. Thus, because claims 6 and 13 (ultimately dependent upon claims 1 and 9, respectively) include limitations that are neither disclosed nor suggested by Shechter, Fuchs, or Steel, alone or in combination, *prima facie* obviousness cannot be established based on the cited references. Accordingly, Applicant respectfully submits that claims 6 and 13 should be allowed. Withdrawal of the rejection under 35 U.S.C 103(a) is respectfully requested.

2) Claims 3, 11, and 19 stand rejected under 35 U.S.C. § 103(a) as unpatentable over Shechter in view of Steel or Eckenfelder, "The Principles of Water Quality Management," 1980, pages 216 and 218. Applicant respectfully traverses the rejection of these claims and respectfully submits that these claims are patentable over Shechter in view of Steel or Eckenfelder for at least the reasons set forth below.

As explained above, claims 3, 11, and 19 include features that are not present in Shechter nor Steel. Furthermore, the teachings of Eckenfelder do not disclose shear forces supplied by large cavities. Instead, Eckenfelder further elaborates the teachings of Steel (oxygen transfer efficiency for bubble aerators) by citing the reason why large bubble diffusers will not yield the oxygen transfer efficiency of fine bubble diffusers. In addition, Eckenfelder builds upon Steel by providing the equation that relates the performance of all air diffusion units. However, neither Steel nor Eckenfelder, alone or combined, teach the shear forces nor the energy consumed while using either fine or coarse bubble aerators. As such, the combination of Shechter in view of Steel or Eckenfelder will not yield the same invention nor advantages Applicant has disclosed.

Thus, because claims 3, 11, and 19 (ultimately dependent upon claims 1, 9, and 18, respectively) include limitations that are neither disclosed nor suggested by Shechter, Steel, or Eckenfelder, alone or in combination, *prima facie* obviousness cannot be established based on the cited references. Accordingly, Applicant respectfully submits that claims 3, 11, and 19 should be allowed. Withdrawal of the 35 U.S.C 103(a) rejection is respectfully requested.

Conclusion

In light of the foregoing amendments and remarks, Applicant respectfully requests reconsideration of this application and allowance of the pending claims.

Respectfully submitted,

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